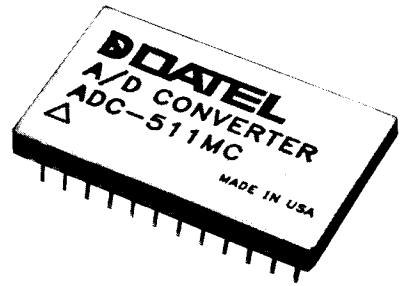
ADC-511
12-Bit, High-Speed, Low-Power A/D Converter

FEATURES

- **12-Bit resolution**
- **1.0 Microsecond maximum conversion time**
- **Low-power, 925 milliwatts**
- **Three-state, output buffers**
- **Functionally complete**
- **Small 24-pin DIP**
- **No missing codes**



GENERAL DESCRIPTION

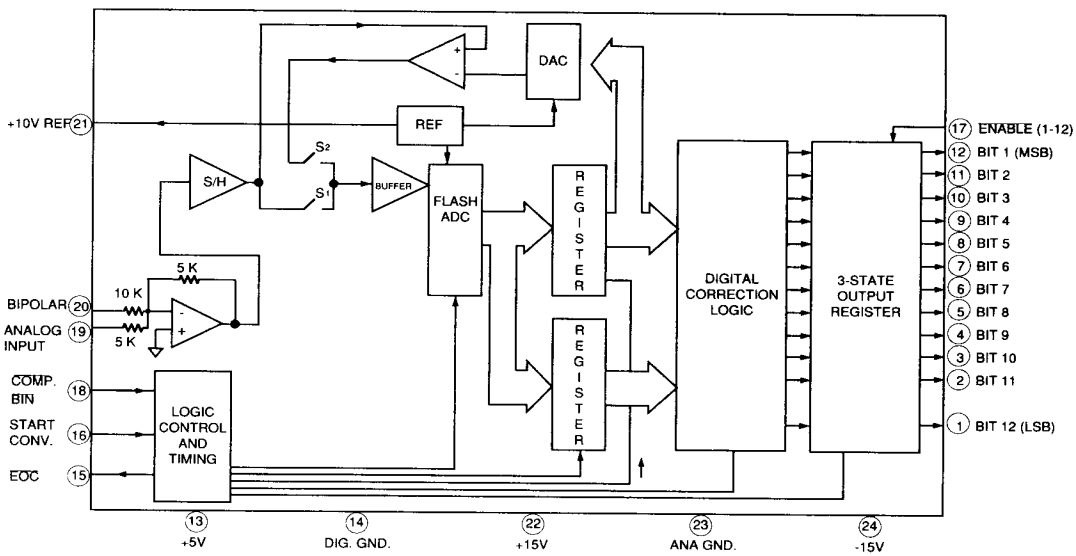
DATEL's ADC-511 uses an advanced design to provide a high-speed, functionally complete 12-bit A/D converter in a small 24-pin DIP. The ADC-511 delivers a conversion speed of 1 microsecond while consuming only 925 milliwatts of power.

Manufactured using thin- and thick-film hybrid technology, the ADC-511's exclusive performance is based upon a digitally-corrected subranging architecture. DATEL further enhances this technology by using a proprietary custom chip and unique laser trimming schemes.

Functionally complete, the ADC-511 contains an internal clock, three-state outputs and an internal reference.

INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	BIT 12 OUT (LSB)	13	+5V
2	BIT 11 OUT	14	DIGITAL GROUND
3	BIT 10 OUT	15	EOC
4	BIT 9 OUT	16	START CONVERT
5	BIT 8 OUT	17	ENABLE (1 - 12)
6	BIT 7 OUT	18	COMP BIN
7	BIT 6 OUT	19	ANALOG INPUT
8	BIT 5 OUT	20	BIPOLAR
9	BIT 4 OUT	21	+10V REF
10	BIT 3 OUT	22	+15V
11	BIT 2 OUT	23	ANALOG GROUND
12	BIT 1 OUT (MSB)	24	-15V



ABSOLUTE MAXIMUM RATINGS

PARAMETERS	LIMITS	UNITS
+15V Supply (Pin 22)	0 to +18	Volts dc
-15V Supply (Pin 24)	0 to -18	Volts dc
+5V Supply(Pin 13)	-0.5 to +7	Volts dc
Digital inputs (Pins 16, 17, and 18)	-0.3 to +7	Volts dc
Analog input	-25 to +25	Volts dc
Lead temp. (10 sec.)	300	° C max.

FUNCTIONAL SPECIFICATIONS

Apply over the operating temperature range and at ±15V dc and ±5V dc unless otherwise specified.

INPUTS	MIN.	TYP.	MAX.	UNITS
Analog Signal Range	–	0 to +10	–	Volts
(See Table 5 also)	–	±5	–	Volts
Input Impedance				
Resistance	2	2.5	–	K Ohms
Capacitance	–	–	50	pF
Logic Levels:				
Logic 1	2.0	–	–	Volts
Logic 0	–	–	0.8	Volts
Logic Loading:				
Logic 1	–	–	2.5	µA
Logic 0	–	–	-100	µA
OUTPUTS				
Resolution	12	–	–	Bits
Logic Levels:				
Logic 1	2.4	–	–	Volts
Logic 0	–	–	0.4	Volts
Logic Loading:				
Logic 1	–	–	- 160	µA
Logic 0	–	–	6.4	mA
Internal Reference:				
+Voltage, +25° C	9.98	10	10.02	Volts dc
Tempco	–	±5	±30	ppm/ °C
External current	–	–	1.5	mA
Output Coding:	Straight binary/Offset binary Complementary binary Complementary offset binary			
PERFORMANCE				
Integral Nonlinearity				
+25 °C	–	±1/2	±3/4	LSB
0 °C to +70 °C	–	±1/2	±3/4	LSB
-55 °C to +125 °C	–	–	±1.5	LSB
Differential Nonlinearity				
+25 °C	–	±1/2	±3/4	LSB
0 °C to +70 °C	–	±1/2	±3/4	LSB
-55 °C to +125 °C	–	–	±1	LSB
Full-Scale Absolute Accuracy				
+25 °C	–	±3	±7	LSB
0 °C to +70 °C	–	±4	±13	LSB
-55 °C to +125 °C	–	±8	±28	LSB
Unipolar Zero Error ①	–	±1	±3	LSB
Unipolar Zero Tempco	–	±13	±25	ppm/°C

PERFORMANCE	MIN.	TYP.	MAX.	UNITS
Bipolar Zero Error ①	–	±1	±3	LSB
Bipolar Zero Tempco	–	±2	±5	ppm/°C
Bipolar Offset Error ①	–	±2	±4	LSB
Bipolar Offset Tempco	–	±17.5	±35	ppm/°C
Gain Error ①	–	±2	±4	LSB
Gain Error Tempco	–	±17.5	±35	ppm/°C
Conversion Time				
+25 °C	–	–	1.0	µSec.
0 °C to +70 °C	–	–	1.0	µSec.
-55 °C to +125 °C	–	–	1.15	µSec.
No missing codes (For 12 binary bits)	Guaranteed over operating temp. range			
POWER REQUIREMENTS				
Power Supply Range				
+15V dc Supply	+14.25	+15	+15.75	Volts dc
-15V dc Supply	-14.25	-15	-15.75	Volts dc
+5V dc Supply	+4.75	+5	+5.25	Volts dc
Supply Current				
+15V Supply	–	+20	+29	mA
-15V Supply	–	-20	-28	mA
+5V Supply ②	–	+65	+79	mA
Power Dissipation	–	925	1250	mW
Supply Rejection	–	–	±0.01	%FSR/%V
PHYSICAL/ENVIRONMENTAL				
Operating Temperature Range				
—MC Models	0	–	+70	° C
—MM Models	-55	–	+125	° C
Storage Temperature Range	-65	–	+150	° C
Package Type	24-pin hermetically sealed ceramic DIP			
Weight	0.42(12)oz.(gram)			

① Specifications cited are at +25 °C. See Techical Note 1 for further information.
② + 5V power usage at 1 TTL logic loading per data output bit.

TECHNICAL NOTES

1. Applications unaffected by endpoint errors or those that remove them through software will use the typical connections shown in Figure 2. The optional external circuitry of Figure 4 removes system errors or helps adjust the small initial errors of the ADC-511 to zero. The external adjustment circuit has no affect on the throughput rate. Table 1 shows how to select the input range.

2. Rated performance requires using good high frequency circuit board layout techniques. The analog and digital grounds are connected internally. Avoid ground-related problems by connecting the digital and analog grounds to one point, the ground plane beneath the converter. This prevents contamination of the analog ground by noisy digital ground currents.

3. Bypass the analog and digital supplies and the +10V reference (pin 21) to ground with a 4.7μF, 25V tantalum electrolytic capacitor in parallel with a 0.1 μF ceramic capacitor. Bypass the +10V reference (pin 21) to analog ground (pin 23).

4. Obtain straight binary/offset binary output coding by tying COMP BIN (pin 18) to +5V dc or leaving it open. The device has an internal pull-up resistor on this pin. To obtain complementary binary or complementary offset binary output coding, tie pin 18 to ground. The complementary signal is compatible to CMOS/TTL logic levels for those users desiring logic control of this function.

5. To obtain Three-State outputs, connect $\overline{\text{ENABLE}}$ (pin 17) to a logic "0" (low). Otherwise, connect pin 17 to a logic "1" (high).

TIMING

Figure 3 shows the relationship between the various input signals. The timing shown applies over the operating temperature range and over the operating power supply range. These times are guaranteed by design.

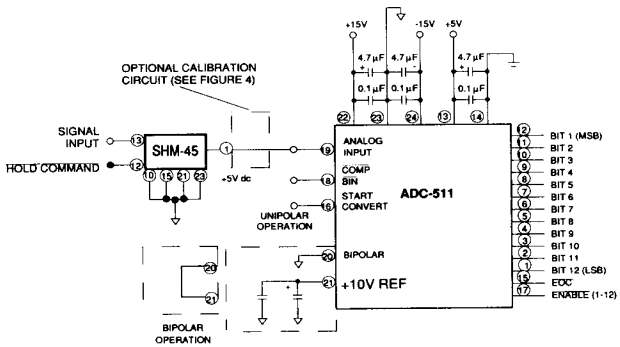


Figure 2. Typical Input Connections for the ADC-511

CALIBRATION

1. The data outputs should be connected to LED's to observe the resulting data values. Connect the converter per Figure 2, Figure 4, and Table 1 for the appropriate Full Scale Range (FSR). Apply a pulse of 200 nanoseconds minimum to the START CONVERT input (pin 16) at a rate of 250 KHz. This rate is chosen to reduce flicker if LED's are used on the outputs for calibration purposes.

2. Zero Adjustments
   Apply a precision voltage reference source between the amplifier's signal input and analog ground. Use a very low-noise signal source for accurate calibration.

   Adjust the output of the reference source per Table 4. For unipolar operation, adjust the zero trimming potentiometer so that the output code flickers equally between 0000 0000 0000 and 0000 0000 0001 with the $\overline{\text{COMP BIN}}$ (pin 18) tied high or between 1111 1111 1111 and 1111 1111 1110 with pin 18 tied low.

   For bipolar operation, adjust the potentiometer such that the code flickers equally between 1000 0000 0000 and 1000 0000 0001 with pin 18 tied high or between 0111 1111 1111 and 0111 1111 1110 with pin 18 tied low.

3. Full-Scale Adjustment
   Set the output of the voltage reference used in step 2 to the value shown in Table 4. Adjust the gain trimming potentiometer so that the output code flickers equally between 1111 1111 1110 and 1111 1111 1111 for pin 18 tied high or between 0000 0000 0001 and 0000 0000 0000 for pin 18 tied low.

   To confirm proper operation of the device, vary the precision reference voltage source to obtain the output coding listed in Table 6.

Table 1. Input Connections

INPUT RANGE	INPUT PIN	JUMPER THESE PINS:
0 to -10V dc	Pin 19	Pin 20 to GROUND
±5V dc	Pin 19	Pin 20 to Pin 21

Table 4. Zero and Gain Adjust

FSR	ZERO ADJUST +1/2 LSB	GAIN ADJUST +FS - 1 1/2 LSB
0 to +10V dc	+1.22mV dc	+9.9963V dc
±5V dc	+1.22mV dc	+4.9963V dc

Table 5. Input Ranges (using external calibration)

INPUT RANGE	R1	R2	UNIT
0 to +10V, +5V	2	2	K Ohms
0 to +5V, ±2.5V	2	6	K Ohms
0 to +2.5V, +1.25V	2	14	K Ohms

Table 6. Output Coding

		STRAIGHT BIN.. COMP. BINARY			
UNIPOLAR	**INPUT RANGES, V dc**	**OUTPUT CODING**		**INPUT RANGE**	**BIPOLAR**
SCALE	**0 to +10V**	**MSB LSB**	**MSB LSB**	**±10V dc**	**SCALE**
+FS -1 LSB	+9.9976V	1111 1111 1111	0000 0000 0000	+4.9976V	+FS -1 LSB
7/8 FS	+8.7500V	1110 0000 0000	0001 1111 1111	+3.7500V	+3/4 FS
3/4 FS	+7.5000V	1100 0000 0000	0011 1111 1111	+2.5000V	+1/2 FS
1/2 FS	+5.0000V	1000 0000 0000	0111 1111 1111	0.0000V	0
1/4 FS	+2.5000V	0100 0000 0000	1011 1111 1111	-2.5000V	-1/2 FS
1/8 FS	+1.2500V	0010 0000 0000	1101 1111 1111	-3.7500V	-3/4 FS
1 LSB	+0.0024V	0000 0000 0001	1111 1111 1110	-4.9976V	-FS +1 LSB
0	0.0000V	0000 0000 0000	1111 1111 1111	-5.0000V	-FS
		OFF. BINARY	COMP. OFF. BIN.		

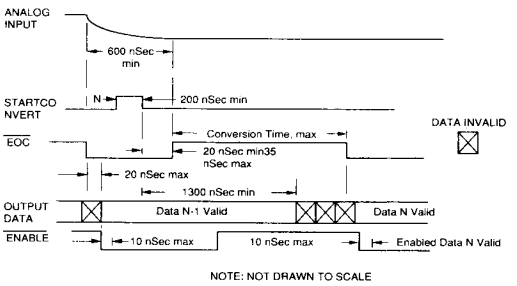
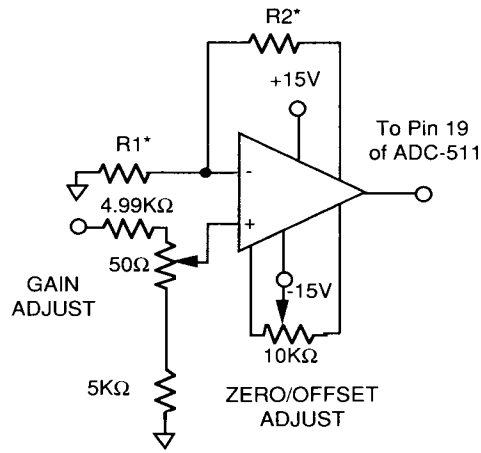


Figure 3. ADC-511 Timing Diagram

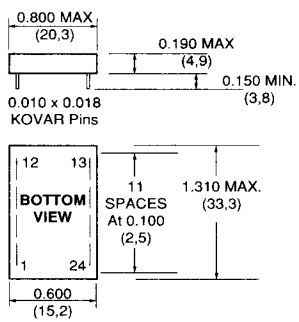
Optional Calibration Circuit



* See Table 5 for R1 and R2 values.

Figure 4. Optional Calibration Circuit

MECHANICAL DIMENSIONS INCHES (MM)



NOTE: Pins have 0.025 Inch ±0.01 standoff from case.

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ORDERING INFORMATION

MODEL	TEMPERATURE RANGE	SEAL
ADC-511MC	0 °C to +70 °C	Hermetic
ADC-511MM	-55 °C to +125 °C	Hermetic
ADC-511/883B	-55 °C to +125 °C	Hermetic

A receptacle for PC board mounting can be ordered through AMP Incorporated, #3-331272-8 (Component Lead Socket), 24 required.